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THE STUDY AND CONTROL OF STREAM POLLUTION IN THE UNITED STATES

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THE STUDY AND CONTROL OF STREAM POLLUTION IN THE UNITED STATES

The problems involved in the control of stream pollution in the United States, though fundamentally the same as in the older European countries of smaller area and denser population, are more or less distinctive by reason of the geography of our country, the rapid rate of increase in its urban population, and the relations between State and Federal Governments.

Present Conditions in the United States:

The predominant practice in sewage disposal in the United States is the discharge of untreated sewage into the most convenient waterway. Sewage treatment plants are at present serving less than twenty per cent of the population of the cities of the first rank; and so far the rate of construction of treatment plants has not kept pace with the rate of increase in sewered population. These conditions prevail, however, not because of undue indifference on the part of the American public, but rather because the dilution afforded by our waterways is generally sufficient to prevent gross nuisance from existing sewage pollution.

Our situation is further distinctive in that the Great Lakes and the large river-systems which receive the untreated sewage from large cities are necessarily used by the same and other cities as sources of water-supply, especially in the central areas. Eventual control over the sewage pollution of these waters must aim, therefore, not merely at prevention of local nuisance, but also at conservation of fitness for use as sources of municipal water-supply. Except in certain areas of the Great Lakes, almost nothing has been done as yet to reduce the pollution of these large waterways, which are consequently becoming more and more polluted as population and industrial development increase. , Nevertheless, in the face of their increasing pollution, the water-supplies taken from them have been greatly improved in recent years by removal of intakes from close proximity to sewer outlets and by improved methods of water-supply purification. We must, however, anticipate a limit to the efficiency of water-purification processes, and must prepare to devise and put into effect some very comprehensive measures for controlling

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the pollution of great river systems and lakes. To accomplish this with due regard for the legitimate but conflicting interests involved, requires the adoption of a national policy, formulated in advance, and consistently followed through a long period of years.

Federal and State Control over Sewage Pollution:

Administrative control over the pollution of waterways (excepting international boundary waters) and the quality of municipal water-supplies is at present exercised solely by the individual States, within their respective boundaries. Whatever potential jurisdiction the Federal Government may hold through its constitutional power to "regulate commerce between the States", no such power is as yet exercised with respect to sewage pollution, except in instances where suit has been brought into the Federal Courts.

The laws of the States regarding the discharge of sewage and other wastes into waterways are extremely diverse; but there is a tendency in recent years towards vesting broad discretionary powers in the State Board (or Department) of Health, and towards some uniformity of policy in administering these laws. The characteristic State organization is a Bureau of Sanitary Engineering in the State Department of Health, charged with the duty of investigating sewage disposal and water supplies in the State, and passing upon all projects for construction, alteration or extension of sewerage, sewage-treatment plants and water-supply plants.

Functions and Activities of the U. S. Public Health Service in Relation to Sewage Disposal and Water Supplies:

The U. S. Public Health Service exercises no administrative control over sewage disposal; and in relation to water supplies its administrative functions are limited to the control exercised over the water supplies furnished by common carriers (railroad trains and boats) to passengers in interstate traffic. This, however, brings the Public Health Service into intimate contact with many municipal supplies and results in considerable moral pressure being brought to bear when the supplies are not satisfactory. It also results in closer relations with the State sanitary authorities, who, acting for the Public Health Service, examine and report upon the water supplies used by interstate carriers from sources within their respective states.

Uniformity of practice on the part of the States in their control over sewage disposal and water-supplies is promoted by the annual conference of State and Territorial health officers with the Surgeon General. In recent years this conference has included a section on sanitary engineering, attended by the sanitary engineers of State health departments who are thus brought into personal touch with each other.

The major work of the Public Health Service in relation to sewage disposal and water-supplies is, however, that of scientific investigation. This activity has been developed chiefly since 1912, when the authority of the Public Health Service to conduct scientific investigations was greatly extended by act of Congress. Prior to that date the authority of the Service to employ its personnel in scientific investigations was rather ill-defined and limited practically to the maintenance of the Hygienic Laboratory. Under the broader authority conferred by the act of 1912, the Service has added to its personnel a staff of sanitary engineers and other technical experts and has engaged in a number of studies relating to sewage disposal and water-supplies. In planning these studies, the Service has, for several years past, had the advice of a group of distinguished consultants.

The investigations undertaken since 1912 may be briefly summarized as follows (not in chronological sequence):

1. Studies of the chemistry and biology of sewage and industrial wastes, with special reference to developing more precise and significant methods for chemical and biological examination. Attention has been devoted especially to development of quantitative determinations of the "relative stability" and "biological oxygen demand" of organic wastes. Due largely to the influence of the Public Health Service, these tests are now very generally applied in the control of sewage-treatment plants in this country, and are rapidly acquiring more significance. More recently, the Hygienic Laboratory has devoted considerable study to the relation between hydrogen ion concentration and the "coagulation" of water in processes of purification.

2. Experimental studies of methods applicable to the satisfactory disposal of various trades wastes and of sewage from isolated homes and small communities.

3. Collective investigations relative to the cost and efficiency of various types of sewage treatment plants in actual operation in the United States.

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4. Studies of the pollution of coastal waters in areas where oyster beds of economic importance are located.

5. Studies of the pollution and natural purification of large rivers, including the Potomac, the Ohio and the Illinois. These, which have been the most extensive of the studies undertaken by the Public Health Service, have furnished a basis upon which to estimate with fair accuracy the extent of the bacterial and chemical purification of sewage-polluted streams resulting from biological action. They have also brought together a large part of the basic data necessary for formulating an eventual policy for control of the pollution in these particular river systems.

6. Studies of the quantitative relations between increasing bacterial pollution of raw water and the quality of the effluent obtained from filtration plants of more or less standardized construction and operation. This includes collective investigations based upon the actual operation of typical municipal plants, and experimental studies utilizing a plant now under construction at Cincinnati.

7. In addition to these studies of general and more or less fundamental problems, the Public Health Service is frequently called upon by State authorities to make investigations and give advice in connection with local problems of sewage disposal or water-supply. These occasional investigations form, in the aggregate, a considerable item in the work of the staff of sanitary engineers.

Rough notes used to background ...

The Status, Study and Control of Stream Pollution in the United States.

Sept. 19, 1923.

1. Fear that subject is not of much interest, and hope that such interest as you have in it may be interest in broad outlines of our situation rather than in details of construction and operation which I am not prepared to give.
Lack of technical knowledge of processes of sewage treatment etc.; accidental contact with the subject.

2. Problems and difficulties in control of stream pollution are fundamentally the same in all highly organized countries -- to provide for water-carriage of excreta and other organic wastes without giving rise to offensive and dangerous conditions --duisance and contamination of water-supplies. In so far as our problems are distinctive it is due to differences in our geography, density of population, rate of increase and form of government.

Present conditions in United States:

3. Though the United States as a whole has a rather low density of population, more than half the population is now urban, and each decade witnesses a relative as well as an absolute increase in our city-dwellers.

	Urban Population of U. S. by decades. Number	Percent of total.
1880	14,770,000	29%
1890	22,700,000	35%
1900	30,800,000	40%
1910	42,600,000	46%
1920	54,300,000	51%

Of the 1920 urban population 38,000,000 (=70%) live in cities of more than 25,000 inhabitants each and about 27,000,000 (50%) live in cities of more than 100,000 population.

Increase in urban population has been steady, though at retarded rate. In larger cities increase has been more than fourfold since 1880, morethan 35% since 1910.

As regards sewerage our cities are fairly well served (85% of population in large cities surveyed in 1920; smaller proportion in smaller cities). In Ohio Valley,(1915) about 72% of urban population was sewered. Sewered population increasing more rapidly than total urban population.

4. Even among our largest cities artifical treatment of sewage is the exception rather than the rule. In 1920 less than 20 % of 83 large cities surveyed (i.e. 22 of 83 cities(27%) comprising less than 20% of population) disposed of sewage through treatment plants. Untreated sewage discharged into rivers 41; lakes, 7; harbors, 13. Of those having treatment plants some have screens only, others treat only part of sewage.

In Ohio Valley (1915) less than 13% of the urban sewage was treated in disposal plants; less than 0.5% of sewage on main stream was treated.

Estimate that treatment plants effect not more than 10% reduction in pollution of our streams in 1920.

Most of the plants, especially the larger ones, have been installed since 1910, and in view of rate of increase in population it is certain that net pollution is on the increase as yet.

Conditions not so bad as they sound, and not result of negligence; but due to enormous dilution available. Effect of Cincinnati sewage upon Ohio River. Dilution in Lakes. Considerable number of cities are now on the border-line of nuisance and beginning to take action. In general treatment has been instituted where conditions have required it for prevention of local nuisance.

5. Further distinctive feature is that many of our cities, both large and small take their water-supplies from large rivers or lakes which at more or less distant points receive the untreated sewage of other communities. Example on Ohio River.

On our largest cities: water supplies come from

Impounded streams in	40%
Underground sources	10%
Rivers & Lakes	50%

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In Ohio Valley 85% from survace sources; 55 % from open rivers.

Though this appears to be an intolerable condition, it is actually not so, since dilution is enormous and pollution localized in Great Lakes, while in our large rivers not only is dilution great, but the distances and times between cities are great (--Ohio River) and while it is of course necessary to purify the water from such sources it is generally possible by modern methods to secure good supplies.

Within past 20 years, even within past 10 years, there has been a notable and general improvement in water supplies of our cities, both the large and the small, due chiefly to:

Relocation of intakes, out of reach of local pollution.
Improvement in mentods of purification.

Evidence of improvement:
Physical and bacteriological (standards of 1913 vs 1923)
Decrease in typhoid death rates in reg. cities.

1900	1910	1920
36.5	22.4	5.5

In 1900 of 37 cities over 100,000 none had rate under 10; 23 had rates of 35 or more; 7 over 50 maximum 144. 50--100 not unusual.

In 1920, of 66 cities over 100,000 none had rate over 16; 58 under 10; and 32 under 5.

Improvement not entirely due to water-supply, but association has been so close as to leave no reasonable doubt that this has been by far the greatest factor.

Ohio River cities.

	TYPHOID DEATH RATES. 1906	1915
Eleven using same water	76.8	74.5
16 using purified water from same sources	90.5	15.3

Instances which could be cited are by the score.

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While we can not state that our water-supplies are even yet entirely safe, we can safely assert that they are not bad, and for the most part are not demonstrably dangerous.

Thus while sewage pollution of our streams has notably increased in past two decades, the quality of water supplies taken from them has consistently and greatly improved. Continues to improve year by year.

However, the time must (presumably) come when improvements in water-purification can no longer outstrip increasing pollution, and when steps must be taken to prevent further contamination of sources by artificial treatment of sewage.

Doubtful that the general public can be interested to extent of acting until they can discern an unmistakable menace to health, in deterioration of quality of water-supplies, and even, perhaps increase in mortality rates, but in the mean time those who are in a position to see ahead need to be at least paving the way for measures which must eventually be undertaken. This then is our great problem-- to safeguard our water supplies against excessive contamination from distant sources -- radically different from the problem of preventing local and obvious nuisance, which is familiar in Europe.

Presents many difficulties:
Scientific: definition of permissible load upon filters.
measurement of natural agencies of purification.
Economic: distribution of cost between water purification and sewage treatment.
to avoid excessive costs by unduly restrictive measures.
to plan gradual changes in sewerage systems, to outlets suitable for treatment purposes.
Legislative: to formulate principles of equity as between conflicting interests; to devise effective but not prohibitive measures for control; to set up suitable administrative machinery, to study situation and adjust differences between States.

May repeat that our problem is distinctly different from and more difficult than that of preventing local nuisance. What we have to do is to control the pollution at distant points within limits as to which we have as yet no definite criteria. We must treat whole river systems as units in some sort of coordinated system of control, extending in most cases over the boundaries of several administrative units, i.e. States.

FEDERAL AND STATE CONTROL:

The U. S. is a federation established by thirteen originally independent and sovereign States. Under the Constitution adopted for the Union and States delegated to the Federal governments certain powers specifically designated, and others by implication; but they reserved to themselves individually all rights not so delegated. The State therefore is the primary unit of soveriegnty in the U. S. and the individual States retain and exercise many of the powers which in European countries are exercised by the central government.

As regards the control of stream pollution, no reference is made to it in the constitution. However among powers delegated is that to regulate commerce between the states and with foreign countries. Navigable streams -- or at least those which form channels of communication between states or with foreign countries are deemed, under this clause to be under jurisdiction of Federal Gov't as regards their navigability. Congress enacts laws and appropriates funds for the maintenance and improvement of navigation on waterways throughout the country. Administered through Engineer Corps of Army. Night soil vs sewage discharge.

As to pollution not affecting navigation, liberal interpretation of interstate commerce clause would give Federal Govt jurisdiction. This however has not been exercised and is not likely to be defined until exercised in legislation. At present there are no Federal statutes in control.

In cases involving interests of two or more States suit may be brought in Federal courts, where decided according to principles of common law and established precedent. State of Mo. vs Chicago San. Dist and State of Illinois. Suit dismissed, but jurisdiction upheld.

STATE LAWS AND PRACTICES:

Laws of the different states relative to pollution of waterways are widely diverse. Sometimes vague and indirect; sometimes sweeping. Recent tendency however is towards vesting broad powers in State Dept. of Health or some other administrative dept. or commission, and there is definite tendency towards uniformity of practice greater than uniformity of laws.

Characteristic organization of sanitary engineering bureau in State Health Dept. and usual duties in investigation, and control of sewerage, sewage disposal and water supplies. Men are of more or less similar training, hence policies apt to be fundamentally similar. Organizations vary, but are generally proportionate to actual needs.

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FUNCTIONS AND ACTIVITIES OF P. H. S.

In regard to sewage disposal has no administrative functions at all.

In relation to water supplies has control over water supplies furnished to interstate passengers on common carriers -- trains and boats. This brings it into relation with most municipal sources also with State authorities and makes a handle for exercising considerable moral pressure.

Annual Conference of State Health Authorities with S. G., including recently organized engineering section.

Chief function of P.H.S. is that of investigation and advice.
Status prior to 1912.
Law of 1912 -- functional increase -- appropriations--personnel.

Staff of consultants.

MAIN LINES OF INVESTIGATION:

Studies of chemistry and biology of sewage and industrial wastes, and of technical methods.
D. O., hydrogen ion, bacteriological methods,

Composition and treatment of industrial wastes. Experimental and collective studies.

Survey of practices and results in municipal treatment plants.

Pollution of coastal waters in relation especially to oyster beds. Cooperation with Dept. of Agriculture.

Pollution and purification of Potomac, Ohio and Illinois rivers.

Bacterial pollution of raw waters in relation to efficiency and cost of purification.

Occasional studies at special request of state authorities; phenol wastes; oil wastes.

PLANT:
Stream Pollution Laboratory at Cincinnati.

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